Evaluating Key Components of a Joint Comprehensive Plan of Action (JCPOA)

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The U.S. administration and its partners in the P5+1 are poised to conclude a momentous agreement with Iran designed to limit its nuclear programs in exchange for significant sanctions relief. Congress has a special responsibility to evaluate this agreement and judge its adequacy to protect U.S. national security interests in the short and long term. As part of this process, it should create legislation to codify the agreement, its implementation processes, critical interpretations of the agreement, reporting requirements, clarifications about violations and consequences of non-compliance, and steps needed to mitigate weaknesses in the agreement.

The legislative branch must determine if the agreement is adequate to achieve the goal it originally set out to achieve – namely instituting international confidence in the peaceful nature of Iran's nuclear programs, not just for the duration of the accord, but for the foreseeable future. Special attention should be given to an agreement whose nuclear limits sunset after 10-15 years, potentially leaving the world with an even more insecure and heightened situation in Iran in terms of a greatly reduced Iranian breakout timeline, and more advanced centrifuges spinning and capable of creating weapon-grade uranium (WGU) within shorter periods of time.

The United States and its allies cannot be certain about their ability to rely mainly on intelligence after the extraordinary arrangements in an agreement end, long after sanctions are removed, and Iran has more freedom to augment its nuclear program. Iran's regional neighbors would likely not wait to develop their own threshold nuclear capability in the face of an Iran that only a decade or two from now would be on the cusp of rapid breakout, capable of producing many nuclear weapons and within a shorter time period than it is today. Thus, Congress needs to proactively consider the implications of this deal for an "enrichment race" in the Middle East that could lead several countries to nuclear weapons capabilities in the next 10-15 years.

Congress should evaluate the technical limits and verification measures set out in the deal to ensure they adequately constrain Iran's nuclear activities and capabilities and its ability to violate the agreement. In particular, the verification arrangements should ensure the reaching of an understanding about past and possibly on-going Iranian work on nuclear weapons and ensure prompt access to any Iranian sites, whether military or civilian. Enforcement will require maintaining leverage against Iran if it cheats, yet reliance on a snapback of sanctions as the only leverage in the case of an Iranian breakout appears deeply ineffective to pressure Iran to reverse course. In addition, the deal needs to be carefully scrutinized in how it guards against

incremental and more ambiguous violations and set out procedures to address this type of cheating.

As Senators think about how to evaluate a nuclear deal, one model is to follow procedures used when the President submits a treaty to the Senate for ratification. Although a Joint Comprehensive Plan of Action (JCPOA) is clearly an executive agreement by nature, it will have a significant impact on U.S. national security and warrants and deserves extraordinary Congressional scrutiny. This scrutiny should not only lead to an up or down vote of the agreement, it should result in legislation that enshrines and elaborates on its provisions and its implementation over time, and makes key interpretations of its provisions. While the Iran Nuclear Agreement Review Act of 2015 satisfies some of the following provisions, Congress should ensure that any new legislation includes those provisions and additional measures and supporting reporting requirements that go further, such as:

- A detailed description of the motivation, intent, and scope of the agreement;
- Key technical and policy interpretations of major provisions;
- Assessments about the adequacy of the agreement's verification regime;
- Clear statements of what constitutes violations, both material and incremental;
- National and international mechanisms to determine a violation and course of remediation;
- Consequences in case of Iranian non-compliance, in particular those that go beyond or complement the snapback of sanctions; and
- Procedures for addressing Iranian unwillingness to comply with remediation or cease the disputed activity.

While a full discussion of such legislation is beyond the scope of this testimony, a few examples would help clarify such an approach. It is important to state that the need for this agreement results from Iran's pursuit of nuclear weapons and secret nuclear capabilities and to provide details about these efforts. It would be useful that legislation lay out Iran's violations of its non-proliferation commitments and describe its history of non-cooperation with the International Atomic Energy Agency (IAEA).

The legislation could contain key interpretations of the deal. The Obama Administration has already stated one interpretation, namely that uranium enrichment is not a right of Iran under the Nuclear Non-Proliferation Treaty. Another it has articulated is that any production of uranium enriched over five percent after the end of the explicit prohibition on such production in the agreement (at year 15) would be viewed as a significant threat to U.S. and international security. Likewise, an interpretation by Congress could be that Iran's expansion of its nuclear program after year 10 of the agreement must be clearly related to the practical need for nuclear energy and consistent with a legitimate and economic, peaceful nuclear requirement.

The legislation could include reporting requirements that require more detailed reports than laid out in the Iran Nuclear Agreement Review Act. Examples include requirements for the administration to produce annual unclassified compliance reports, including review and determination of the on-going adequacy of the agreement's verification regime. More frequently, the administration should report on the adequacy of Iran's cooperation with the

IAEA. Congress should be informed quarterly about the size of Iran's low enriched uranium (LEU) stocks, both less than 5 percent and less than 20 percent enriched, and whether the breakout timelines remain as they should. The administration should also inform Congress in detail about the status of Iran's centrifuge research and development programs.

The legislation could also establish implementation steps. Some have suggested that there should be a senior administration official responsible for implementation. The IAEA's verification efforts in Iran should be supported with additional funding and other types of U.S. support. In addition, there should be actions to strengthen U.S. export control and counterproliferation efforts against Iran's illicit procurements for its missile and military programs and its potential illicit nuclear or nuclear-related procurements. As part of that effort, it is important to improve U.S. programs for the timely detection of Iran's illicit procurement attempts, utilizing and developing new technologies, and to expand cooperation with allies to improve timely detection of Iran's illicit trade.

The remainder of my testimony seeks to address specific questions posed by the Chairman in his invitation letter. Because of the complexity of some of the questions, a few of the responses are more technical than usually presented in Congressional testimony. Nonetheless, I hope the testimony is useful. If desired, I can provide additional supporting information or elaborations.

1) What criteria should Senators use to evaluate a prospective nuclear agreement with Iran?

In particular, criteria weighing the adequacy of an agreement should include:

- The blockage of the four main pathways to the bomb: the Arak/plutonium production pathway, Natanz/enrichment and Fordow/enrichment pathways, and covert pathways.

- Achievement of a 12-month breakout timeline during the first ten years of the agreement and a six-month breakout timeline remaining at year 13.

- The size of the near 20 percent LEU stock is consistent with a 12 month breakout timeline. In particular, is the administration making assumptions to unreasonably exclude portions of a remaining stock of near 20 percent LEU?

- The methods, and their effectiveness or timeliness, in reducing Iran's 3.5 percent LEU stockpile from its current level of about 10,000 kg to the 300 kg cap agreed in the April 2015 interim agreement. How will this cap be maintained during the agreement?

- Adequate verification, including the adequacy of Additional Protocol Plus arrangements.

- Inspector access to Iranian sites where suspicious activity may be occurring, including military sites, anywhere and promptly, or "anytime," and certainly within 24 hours. In particular, if the agreement creates a P5+1 deliberative body that has the authority to decide upon IAEA access in case of an Iranian refusal, the length of the proceedings

should not increase access time significantly or create a process that Iran can exploit to buy time to hide or destroy evidence at suspect sites.

- An Iranian commitment not to conduct illicit nuclear and nuclear-related trade.

- A procurement channel under a United Nations Security Council resolution that controls a sufficient number and type of goods and includes adequate monitoring. As part of verifying Iran's compliance with this condition, the IAEA should ensure that Iran's procurement of nuclear and nuclear-related goods is within this channel and be mandated to investigate violations. The IAEA should be able to have access to the actual end users of goods imported by Iran through this channel and those who have illicitly procured outside this channel.

- The deal can survive stress tests, namely assessments of the durability and adequacy of the agreement against a variety of scenarios that project the status and behavior of the Iranian regime in the future, such as ten and fifteen years after the agreement is signed. It is critical to evaluate the agreement's projected goals and endpoints against an Iranian regime that acts more responsibly than today as well as less responsibly. The durability, strength, and value of any deal is truly measured against an Iranian regime that remains as it is today or worsens in terms of impact on U.S. interests regionally and internationally.

- Understandings that at year 13 after implementation of the deal, and in particular at year 15, any Iranian nuclear expansion of uranium enrichment efforts or building of heavy water reactors will be based on legitimate economic rationales and clearly needed for civilian purposes. Any indications, based on Iranian statements in the negotiations or learned by U.S. intelligence, that Iran intends to enrich over 3.67 percent after year 15 of the agreement should be weighted negatively.

- Evaluating the implications of the deal establishing a new norm that legitimizes uranium enrichment despite the lack of need for the enriched uranium and a history of non-compliance and non-cooperation with the IAEA. Will the deal herald an "enrichment race" that threatens U.S. interests regionally and more broadly? Congress should evaluate this threat of the spread of dangerous nuclear technologies and develop remediation steps to mitigate damages.

2) What concerns do you have about the interim agreement announced on April 2, 2015?

Overall, the interim agreement achieved many U.S. objectives; however, it also raised several concerns. In an ISIS report published on April 11, 2015, we outlined in fuller terms the agreement's accomplishments, several weaknesses, and a number of unresolved issues.[1]

[1] Albright et al., "P5+1/Iran Framework: Needs Strengthening," ISIS Report, April 11, 2015. http://isis-online.org/uploads/isis-reports/documents/Assessment_of_Iran_Nuclear_Framework_April_11_2015-final.pdf

The interim agreement succeeded in limiting the Arak heavy water reactor sufficiently, reducing Iran's centrifuge program in size, and increasing transparency and monitoring of a long-term deal. Other important provisions contained in the Fact Sheet of the interim deal include:

- No new enrichment facilities for 15 years;
- The removal and monitored storage of excess centrifuges and associated equipment and not their disablement in place, as was discussed in the past as a preferred possibility by the U.S. negotiators;
- In particular, the removal and monitored storage of the roughly 1,000 IR-2m centrifuges at the Natanz Fuel Enrichment Plant and the removal and storage of the several hundred IR-2m and IR-4 centrifuges at the Natanz pilot plant;
- The removal from Iran[2] or blending down of most of Iran's stock of about ten tonnes of 3.5 percent LEU and a long term cap of 300 kg of LEU hexafluoride enriched no more than 3.67 percent (Iran can possess other chemical forms of this LEU but these amounts must fall within the cap, after calculating their hexafluoride equivalent);
- Excess centrifuges and associated equipment can be used only as replacements for operating centrifuges and equipment, removing any need for further operation of IR-1 and IR-2m centrifuge manufacturing operations and procurements;
- Containment and surveillance of centrifuge component manufacturing plants; and
- A procurement channel for goods needed in authorized nuclear programs.

Concerns:

❖ There are numerous concerns about whether the deal adequately addresses limits on Iranian enrichment which have implications for maintaining the 12-month breakout timeline.

- The U.S. Fact Sheet about the interim agreement makes no mention of Iran's stock of near 20 percent LEU, in particular its fate. How much near 20 percent LEU will Iran retain? How will the excess be determined? Will that excess be shipped out of Iran or diluted to natural uranium? Maintaining a 12-month breakout timeline depends critically on the size of Iran's remaining stock of near 20 percent LEU and its accessibility in a breakout (see also question 6). As of June 30, Iran will retain a dangerously large stock of near 20 percent LEU, namely about 230 kilograms (kg) of near 20 percent LEU. This LEU will be in three principal categories, namely about 45 kg projected to be in oxide powder form, approximately 135 kg in waste, in scrap, or in-process and roughly 50 kg in fuel elements for the Teheran Research Reactor (TRR).[3] ISIS has recommended the stocks of oxide powder and in waste/scrap/process be blended down to natural uranium or shipped out of Iran. The LEU in fresh or unirradiated TRR fuel should also be made less usable in a breakout. One method to do that is to irradiate all the TRR fuel, at least partially, to increase the complication of extracting the LEU from the fuel. On the other

[2] Iran may be reconsidering the option of sending LEU to Russia for fabrication into fuel for subsequent return to Iran for use in the Bushehr nuclear power reactor.
[3] David Albright and Serena Kelleher-Vergantini, "The U.S. Fact Sheet's Missing Part: Iran's Near 20 Percent LEU, (Updated June 5, 2015 with new IAEA data)," ISIS Report, June 5, 2015. http://isis-online.org/uploads/isis-reports/documents/LEU_20_percent_update_June_5_2015_Final.pdf

hand, the administration appears willing to allow Iran to keep the bulk of this near 20 percent LEU, as long as it is mixed with aluminum, a step in the manufacturing process of TRR fuel. The JCPOA should be carefully scrutinized as to whether or how these recommendations are implemented and in particular it should be assessed as to whether the breakout calculations should include near 20 percent LEU recovered from LEU/aluminum mixtures. We believe they should.

- The interim agreement does not provide the mechanisms to reduce Iran's 3.5 percent LEU stockpile from its current level of about 10,000 kg to the 300 kg cap. Excessive stocks of 3.5 percent LEU also negatively impact the 12-month breakout timeline. About 4,000 kilograms of this LEU are slated to be converted into oxide powder, albeit far behind the schedule implied in the Joint Plan of Action (JPOA). In fact, Iran has not met its commitments at the end of the first period of the JPOA and its first extension to turn newly produced 3.5 percent LEU into oxide form. It is doubtful it will do so at the end of the current extension that ends on June 30, 2015. The administration has publicly downplayed this condition in the JPOA, focusing on a weaker condition that Iran feed the newly produced LEU into the uranium conversion plant, a technically simple step to accomplish. The result is that this 4,000 kg of LEU will likely be in several chemical forms, most not amenable to blending down to natural uranium without further chemical processing. Some of the LEU could be in chemical forms that may not be amenable to either blending down or shipping out of Iran. Congress should carefully scrutinize the arrangements in a deal to achieve a cap of 300 kg of 3.5 percent LEU hexafluoride equivalent.

❖ Of concern is the lack of a "soft landing" or slow return to shorter breakout timelines after year 10 and up to year 15. Iran will also be able to deploy advanced centrifuges after year 10. In fact, one senior negotiator described the arrangement for centrifuges as a reversed program in years one to ten, preparation for full development in years 10 through 13, and full development after year 13. A major concern is that Iran can return to short breakout timelines, likely far shorter than the two months or so projected today.

- Lack of limits on Iran augmenting its enrichment capacity after year 10. ISIS has recommended that breakout time should decrease no faster than one month per year, resulting in a breakout time of 7 months at year 15. During this five year period, no IR-2m, IR-4, or more advanced model centrifuges should be deployed.

- Lack of a "sunset clause" for the agreement authorizing the path forward for Iran, or at year 13 the ability for the P5+1, collectively or individually, using IAEA findings and other, nationally developed information, to determine if Iran's nuclear program is consistent with a peaceful program, exclusively for peaceful purposes, and expected to remain so. Such a positive determination would then free Iran to deploy large numbers of its centrifuges and thereby lower breakout timelines.

- Lack of a condition that explicitly states that Iran would not enrich beyond the 3.67 percent indefinitely, rather than the current provision to ban such enrichment for just 15 years. Iran is unlikely to have a civilian justification for producing enriched uranium

above 3.67 percent after year 15. Iran enriching at near 20 percent would undoubtedly risk increasing international concerns about its intentions and create precedents for other nations to follow.

- The weakness of provisions limiting centrifuge research and development (R&D) during the first ten years of the agreement.

  - No bans exist on Iran's research and development of the IR-6 and IR-8 centrifuges, the latter of which is up to 16 times more powerful than the IR-1 centrifuge. Failing to achieve such bans, the interim agreement does not appear to mitigate the risks of Iran being able to deploy these more powerful centrifuges after year 13, other than some negotiators stating that they believe that Iran will have trouble actually deploying them in the future.

- Lack of additional conditions on Iran's allowed work at the Fordow site for the indefinite future, because of its sensitive nature of being deeply buried and difficult to access or penetrate in the event of cheating or breakout.

  - An existing loophole in the interim agreement allows Iran to operate advanced centrifuges at Fordow after year ten, albeit not enriching uranium. ISIS has recommended that a deal should prevent Iran from ever using Fordow to enrich uranium or only allow it to enrich in IR-1 centrifuges.

  - After year 15, Iran could deploy any of its centrifuges at Fordow to enrich uranium, allowing it to reestablish Fordow as a uranium enrichment centrifuge plant with a capacity far in excess of its current capacity. Unless additional limits are included in the agreement, Fordow could re-emerge as a substantial uranium enrichment plant after year 15, housing advanced centrifuges 10 to 16 times more capable than the IR-1 centrifuge. So, instead of a plant with a current capacity of about 2,500 separative work units (swu) each year, the plant would have a capacity of 25,000- 40,000 swu per year. Since bans to produce near 20 percent LEU also sunset at year 15, this heavily fortified plant would be capable of producing enough weapon-grade uranium for a nuclear weapon within a few weeks, or enough WGU for two weapons in less than a month.

Unresolved issues:

- The interim deal was largely silent on verification conditions of key importance, including (described in detail under question 4, page 11):

  - Anywhere, anytime access to Iranian military sites,
  - The need for a broad centrifuge-related declaration,
  - A raw uranium import declaration,
  - Key import and export declarations of sensitive or dual-use goods, and
  - A plutonium related declaration.

Our concerns about the interim deal outlined above should not be construed as opposition to the deal, particularly since the deal has yet to be finalized. Our judgement about a deal has to await the final details. Our concerns, however, provide another measuring stick upon which to evaluate a final agreement.

3) What redlines do you believe Senators should hold in evaluating a prospective nuclear agreement with Iran?

The U.S. government's redlines have been difficult to identify. Iran has been far clearer about its redlines. Nonetheless, if a redline is defined as a condition that if unmet would immediately mean that the deal would be rejected, several key ones that should be considered are:

- Estimated breakout time, or the time to produce one significant quantity of fissile material for a nuclear weapon, is adequate to allow enough knowledge and time for action or intervention to stop Iran. In the words of Undersecretary of State Wendy Sherman: "We must be confident that any effort by Tehran to breakout of its obligations will be so visible and time-consuming that the attempt would have no chance of success."

- The rollback of Iran's centrifuge program and Arak reactor modifications are irreversible during the duration of the agreement, or at least not significantly reversible within 12 months of Iran's initiation of a reversal;

- A clear, timely pathway exists whereby the IAEA's concerns are addressed about the possible military dimensions of Iran's nuclear program, both in the past and those possibly ongoing today. Ambiguity over Iran's nuclear weaponization accomplishments and residual capabilities risks rendering an agreement unverifiable by the IAEA. This pathway cannot simply involve Iran checking boxes and the IAEA or the United States accepting Iranian explanations. It must be accompanied by full Iranian cooperation with an IAEA investigation, including access to sites, people, and documents related to its past or possibly ongoing efforts; and

- Prompt IAEA access is guaranteed to all sites in Iran, whether military or not, if suspicious activities are reported.

4) Are there requirements on inspections or possible military dimensions (PMD) that you believe are essential to a successful agreement? Do you believe there are other required elements of a successful agreement?

A prerequisite for a comprehensive agreement is for the IAEA to know when Iran sought nuclear weapons, how far it got, what types it sought to develop, and how and where it did this work. Was this weapons capability just put on the shelf, waiting to be quickly restarted? The IAEA needs a good baseline of Iran's military nuclear activities, including the manufacturing of equipment for the program and any weaponization related studies, equipment, and locations. The IAEA needs this information to design a verification regime and determine if Iran's nuclear program is peaceful today.

One important aspect of this issue has been the IAEA gaining access to a site at the Parchin military complex. This site is the alleged location of high-explosive testing linked to nuclear weapons development prior to 2004. Since the IAEA asked to visit this site in early 2012, Iran has reconstructed much of it, making IAEA verification efforts all but impossible. Tehran has undertaken at this site what looks to most observers as a blatant effort to defeat IAEA verification. Because of such extensive modifications, the IAEA, once allowed access, may not be able to resolve all its concerns. Thus, access to Parchin alone is no longer sufficient to resolve the issues underlying the IAEA's original request to access this site. The IAEA will need to visit related sites. One needs to now think of IAEA access to Parchin as including a list of actions that would involve the need for access to additional sites and individuals. More broadly, Iran will need to allow access to a range of sites as part of addressing the IAEA's PMD concerns.

For a deal to be verifiable, Iran will also need to agree to IAEA requests to interview key individuals, such as Mohsen Fakhrizadeh, a reputed leader of Iran's nuclear weapons efforts, and Sayyed Abbas Shahmoradi-Zavareh, former head of the Physics Research Center, alleged to be the central location in the 1990s of Iran's militarized nuclear research. The IAEA interviewed Shahmoradi years ago about a limited number of his suspicious procurement activities conducted through Sharif University of Technology. The IAEA was not fully satisfied with his answers and its dissatisfaction increased once he refused to discuss his activities for the Physics Research Center. Since the initial interviews, the IAEA has obtained far more information, some supplied by my institute, about Shahmoradi and the Physics Research Center's procurement efforts.[4] The need to interview both individuals, as well as several others, remains.

There had been an expectation, or at least a hope, that Iran would address the IAEA's PMD concerns prior to the June 30 deadline. However Iran has become more intransigent on this issue over the last several months, eliminating any such hope. Because this issue is fundamental to resolving the nuclear issue, Iran's intransigence requires extra assurance early on in any deal that it will comply with its safeguards obligations and meet the fundamental goal of a long term deal that Iran's nuclear program be strictly peaceful.

The administration has reportedly proposed to Iran that it allow access to a list of many sites and persons that are relevant to the IAEA's PMD concerns, prior to the lifting of key financial and economic sanctions. As of late last week, Iran had not accepted this list. But even if it does, it could mechanistically allow the IAEA access to these sites and persons while showing no real cooperation. As discussed above, the risk is too high that Iran would treat the exercise as simply checking a box, leaving the IAEA no further along in its effort to address its PMD concerns. If Iran can do this before the removal of sanctions, one can have little confidence that it will address the IAEA's concerns afterwards.

If Iran successfully stonewalls the IAEA prior to the lifting of sanctions, the IAEA's credibility will be undermined. Further, Iran may be able to maintain all of the knowledge and capabilities related to nuclear weapons that it has acquired and developed for a future date when it may want

[4] See for example, Albright, Paul Brannan, and Andrea Stricker, "The Physics Research Center and Iran's Parallel Military Nuclear Program," ISIS Report, February 23, 2012. http://isis-online.org/uploads/isis-reports/documents/PHRC_report_23February2012.pdf

to break out of its non-proliferation obligations. Leaving Iran's past accomplishments in the shadows would solve nothing if in the future it can muster nuclear weapons capabilities unknown to the IAEA and the international community, to make nuclear weapons. As a result, Congress should look for more from the deal, namely prior to the lifting of sanctions, Iran should resolve in a significant and concrete manner the IAEA's concerns about its past and possibly ongoing work on nuclear weapons. Although Iran addressing all of the IAEA's PMD concerns would be ideal, that process will likely take years. The following aims to identify a sufficient set of conditions that are straightforward and realistic to achieve in the initial implementation period of an agreement. These conditions, or equivalent ones, should be included in a set of requirements that Iran must meet before key financial and economic sanctions are lifted:

- Iran accepting a robust list for visits to sites where nuclear weapons-related activities are alleged to have taken place (such as Parchin but involving at least a half a dozen sites); and access to key equipment, companies, and individuals identified by the IAEA as associated with past military nuclear related activities. Congress should on a classified basis compare this list to earlier proposed ones by the administration and its allies and require the administration to provide an explanation for which specific items were removed and why. (The list should not in any way be considered a final list; the IAEA will need to reserve the right to go to other sites, interview the same or different people, and obtain other documents as it seeks to finalize its PMD investigation, some of which will likely have to occur after the lifting of sanctions).
- The IAEA receiving full cooperation from Iran in its efforts to conduct a rigorous investigation of PMD issues.
- Prior to the lifting of key sanctions, the IAEA having time to assess the results of these visits and access and make a preliminary determination over whether it has made concrete progress. Such a positive IAEA determination would be necessary to lift sanctions.
- If appropriate, the IAEA issuing a provisional determination, and Iran not disagreeing, that it had a nuclear weapons program prior to 2004, parts of which may have continued after 2004.
- The U.S. intelligence community issuing a detailed unclassified dossier describing to the best of its knowledge, albeit incomplete, Iran's past nuclear weapons program and more recent activities that are useful for the development of nuclear weapons or that are associated with research in fields of nuclear weapons development, such as those conducted by the Organization of Defensive Innovation and Research (SPND), headed by Mohsen Fakhrizadeh.[5]

[5]U.S. State Department, "Additional Sanctions Imposed by the Department of State Targeting Iranian Proliferators." Media Note, Office of the Spokesperson, Washington, DC, August 29, 2014. http://www.state.gov/r/pa/prs/ps/2014/231159.htm The State Department note states:

> "SPND was established in February 2011 by the UN-sanctioned individual Mohsen Fakhrizadeh, who for many years has managed activities useful in the development of a nuclear explosive device. Fakhrizadeh led such efforts in the late 1990s or early 2000s, under the auspices of the AMAD Plan, the MODAFL subsidiary Section for Advanced Development Applications and Technologies (SADAT) and Malek Ashtar University of Technology (MUT). In February 2011, Fakhrizadeh left MUT to establish SPND. Fakhrizadeh was designated in UNSCR 1747 (2007) and by the United States in July 2008 for his involvement in Iran's proscribed WMD activities. SPND took over some of the activities related to Iran's

- After the lifting of sanctions and the implementation of the deal, a lack of Iranian cooperation with the IAEA on the remaining PMD issues would be considered a material breach of the JCPOA. It should be noted again that the IAEA investigation of the PMD issues could last well past the date when key sanctions are lifted. This on-going IAEA investigation will require access to additional sites, individuals, and documents.

Olli Heinonen, former chief of IAEA safeguards and now at Harvard University's Belfer Center, has pointed out that Iran checking off a list is "not sufficient to provide understanding on how far Iran got in various parts of its weapons related R&D."[6] Such a list could be useful for the IAEA to establish "choke points," he added, which can be monitored to ascertain that a nuclear weapons program is not restored. This would require on-going, periodic access to these sites and individuals.

In addition, the IAEA investigation into PMD should be iterative, according to Heinonen. That means that new persons, sites, and documents may arise during the discussions. Access to those persons, sites, and documents should also be provided. One also has to keep in mind that some activities could have been moved or will be moved to other military sites. If any new suspicions arise, the IAEA will need access to those sites as well.

Heinonen also notes that it is important to dismantle any single use (nuclear weapon) capability in Iran, if they still exist. The agreement may go further, however, according to several negotiators, and ban certain nuclear weaponization-related activities. Examples of such activities include uranium and plutonium metallurgy and certain types of neutron generator and high explosive work. Achieving these bans and their verification conditions in the final deal is challenging but important to achieve.

A difficult verification area is whether Iran has obtained nuclear weapons assistance from other countries or cooperated with other countries on sensitive nuclear matters. The Khan network is suspected of having provided Iran with nuclear weapons designs. There are suspicions that Iran and North Korea are cooperating on nuclear matters. As a result, a challenge is how to verify that Iran is not outsourcing nuclear technology or cooperating with other countries on sensitive nuclear issues.

Verification conditions of key importance, some of which were outlined above, that are not addressed in the framework agreement or not addressed in much detail include:

Anytime, Anywhere Access: The IAEA will need anywhere, prompt, or "anytime" access to all relevant sites, facilities, material, equipment, people, and documents in Iran.

Centrifuge Related Declarations: In addition to the broader declarations needed to address the IAEA's PMD concerns, the verification arrangements will also depend on Iran declaring how many centrifuges, of all types, that it has made and its inventory of raw materials and equipment

undeclared nuclear program that had previously been carried out by Iran's Physics Research Center, the AMAD Plan, MUT, and SADAT."

[6] Personal communication with Olli Heinonen.

for its centrifuge program. This baseline is necessary if the agreement is to provide assurances about the absence of secret centrifuge activities and facilities now and in the future.

With regard to establishing a baseline on the number of centrifuges made by Iran, verification of centrifuge manufacturing is necessary, including the declaration and verification of key raw materials and components. The declaration needs to include the origin and amounts of key raw materials and the total number of major components, including the number held in stock, the number manufactured or procured, and their fate. A description of the locations used to produce these goods will also be needed.

Without knowledge of past centrifuge manufacturing activities, centrifuge-related equipment and raw material inventories, and centrifuge-related procurements, verification cannot be adequate. Covert stocks of centrifuges and related equipment and materials could exist and be kept outside the purview of the inspectors. Ensuring a full declaration of the past should be a priority.

Raw Uranium Declarations: Another element is the rigorous verification of uranium obtained from abroad and produced domestically, via any method in the past, present, and future. The framework deal signed in early April provides for the continuous surveillance of uranium mills over a twenty five period. A final deal also needs to ensure that Iran cooperates with the IAEA in making a full, verified accounting of past uranium purchases and production.

Key Import/Export Declarations: Iran should also provide the IAEA with details of past and future imports, exports, and uses of key items listed under INFCIRC 254 parts 1 and 2 and other critical goods that are used in Iran's nuclear programs. These declarations would go beyond the ones in the Additional Protocol and Iran's commitment to make these declarations should be in the comprehensive deal.

Plutonium Related Declarations: As part of broader declarations, the JCPOA should also include a provision for verification of any past activities related to the separation of plutonium. These declarations should include information on any actual or attempted procurements related to acquiring capabilities to separate plutonium from irradiated material.

5) What effect do you believe a prospective agreement would have on the Nuclear Nonproliferation Treaty (NPT)? On regional proliferation?

The Iran deal may have the unintended consequence of stimulating a uranium "enrichment race." In expectation of an Iran deal, Saudi Arabia is already indicating that it will match Iran's nuclear capabilities. Prince Turki bin Faisal, the 70-year-old former Saudi intelligence chief, has toured the world with the same message: "Whatever the Iranians have, we will have, too," he said at a conference in Seoul, South Korea. Other Sunni states apart from Saudi Arabia may accelerate their drive to develop their own domestic nuclear programs, even programs to enrich uranium, as they too seek to counterbalance Iran. Iran's other regional rivals such as Egypt and Turkey may seek to initiate or expand domestic nuclear enrichment programs in order to preserve their regional influence.

The deal, rather than curbing the spread of dangerous nuclear capabilities, could as one aftereffect create a new norm that legitimizes uranium enrichment programs almost anywhere, even when unneeded for a civilian nuclear program and conducted by a country posing a clear proliferation risk. Instead of a deal that sets conditions that are so onerous that no one would want to follow that path, the conditions on Iran may be seen as bearable to other states. Moreover, if they first act by placing their programs under IAEA safeguards, they may avoid the burdensome sanctions that Iran has faced, despite being in regions of tension such as the Middle East.

Congress and the administration must critically assess where the agreement will leave Middle East regional security after year ten of a deal and ascertain whether the agreement would leave the region in greater turmoil or actually succeed in reigning in future proliferation. A sound agreement that introduces unprecedented transparency for the foreseeable future into Iran's activities and intentions, while limiting its ability to expand its program immediately after the agreement sunsets, may be an agreement that Iran's neighbors could live with and exercise restraint over regarding their own nuclear development. However, the net result of this deal may leave the Middle East facing a greater nuclear proliferation danger from the spread of sensitive technologies stimulated by a new, dangerous norm legitimizing enrichment almost anywhere. As part of evaluating an Iran deal, Congress should evaluate this threat of the spread of dangerous nuclear technologies and develop remediation steps to mitigate damages.

In terms of impact on the NPT, the agreement's effects may be that non-nuclear weapon states (NNWS) more generally will exercise less restraint on developing fuel cycle capabilities that are of proliferation concern. They may view Iran's legitimized nuclear program as a new standard that can be reached by all NNWS. The Nuclear Suppliers Group and strong U.S. diplomacy will be required to convince additional states not to pursue the Iran path, which they may attempt through safeguarded means instead of trying to build covert advanced fuel cycle facilities, but with similar results for creating insecurity internationally and within their regions.

6) How do you believe the administration is calculating break out time? Are they taking into account all forms of uranium that could be used to work toward a weapon?

The administration's method of calculating breakout is classified and not available publicly. For many years we have also calculated breakout timelines in collaboration with centrifuge experts at the University of Virginia. Our understanding from U.S. officials is that the U.S. methods and ours are similar in approach. In some cases, we agree with the U.S. breakout estimates, particularly when we start from the same number and type of centrifuges and the same quantity and enrichment level of LEU. However, in other cases we have disagreements over the amount of LEU available for use by Iran in a breakout. In particular, we assess that Iran would have available more near 20 percent LEU in a breakout than does the U.S. government. As a result, in that case, our timelines are less than 12 months. We are also concerned that prior to a breakout Iran would accumulate more 3.5 percent LEU hexafluoride than allowed, namely 300 kg of LEU hexafluoride, enabling a faster breakout.

In addition, we have concerns over whether the agreement will sufficiently ensure that Iran cannot reinstall excess, dismantled IR-1 and IR-2m centrifuges. In particular, we are worried that Iran will be able to reinstall about 1,000 IR-2m centrifuges and some number of IR-1 centrifuges in several months, a timeframe we assess as sufficient to allow these centrifuges to significantly reduce the breakout timeline below 12 months.

After the limitations on centrifuge deployments start to end in year ten of the agreement, we believe that breakout timelines will begin to decrease steadily and too rapidly. In addition, Iran has significant potential to master advanced centrifuges by this time and thus reduce breakout timelines more rapidly than expected after year 13 of the deal.

Several of these issues are still in play in the negotiations and hopefully will be resolved to achieve and guarantee a 12 month breakout timeline during the first ten years of the deal and create a soft landing for breakout timelines afterwards. Nonetheless, during Congress' evaluation of an agreement, these issues should be closely scrutinized and evaluated and, if necessary, mitigation strategies called for and developed.

Similar Breakout Results as the Administration

Our similarity in result to the U.S. administration's breakout estimates can be seen when considering the centrifuge limits Iran has accepted in the interim deal of April 2015. In the case of about 6,000 IR-1 centrifuges and a stock of 300 kilograms of 3.5 percent LEU hexafluoride and no available near 20 percent LEU hexafluoride, our breakout estimate would have a mean of about 12-14 months, where the minimum breakout time would be 11-12 months.[7] We have used the mean as the best indicator of breakout time and interpret the minimum time as a worst case. Thus, our estimate of breakout would confirm the United States' assessment that these limitations satisfy a 12-month breakout criterion.

Iran's Stock of Near 20 Percent LEU[8]

However, breakout estimates depend critically on Iran's usable stock of near 20 percent LEU. For example, Iran can significantly lower breakout times by inserting into the cascades a relatively small amount of near 20 percent LEU. If it recovers only about 50 kilograms of near 20 percent LEU hexafluoride (or 34 kg of LEU (uranium mass), or about 15 percent of its current stock of near 20 percent LEU) within the first six months of breaking out, and we assume the same conditions as above, the mean breakout time becomes about 10-11months, with a minimal time of about nine months. As a result, minimizing or ensuring that the near 20 percent LEU stock is unusable in a breakout is a necessity. The breakout times would be expected to be even lower, since if Iran decided to break out, it may have access to more near 20 percent LEU and it

[7] More recent ISIS calculations that assume a more efficient average arrangement of the cascades lower our previous estimates somewhat compared to earlier ones. This reflects a view that Iran may keep under a deal its cascades that are the more efficient ones.

[8] For additional detail and sources see David Albright and Serena Kelleher-Vergantini, "The U.S. Fact Sheet's Missing Part: Iran's Near 20 Percent LEU, (Updated June 5, 2015 with new IAEA data)," ISIS Report, June 5, 2015. http://isis-online.org/uploads/isis-reports/documents/LEU_20_percent_update_June_5_2015_Final.pdf

could also be expected to have accumulated additional 3.5 percent LEU above the cap of 300 kg (see below).

The accumulation of 34 kg of near 20 percent LEU (uranium mass) represents only a small fraction of Iran's inventory of this LEU. Despite the fact that Iran no longer has a stock of near 20 percent LEU in hexafluoride form (UF_6), it continues to retain a significant portion of this material in the form of oxide (U_3O_8) and in scrap and waste. As discussed earlier, in total, Iran possesses about 228 kg of near 20 percent LEU (uranium mass). Extrapolating to the end of June 2015, which is the end of the second extension under the JPA and the target date for a comprehensive agreement, Iran is estimated to have about 43 kg remaining in near 20 percent LEU oxide powder and about 130-134 kg in scrap, in waste, and in-process (all uranium masses). Only about 50 to 54 kg of this LEU are expected to be in Tehran Research Reactor (TRR) fuel, or only about 22-23 percent of the total near 20 percent LEU. This extrapolation assumes that Iran will fulfill its commitments under the second extension to use all 35 kg of LEU oxide to make fuel. If it does not, then the estimate of oxide powder will be slightly greater and the amounts in fuel slightly less that projected.

Much of this LEU material is in forms where the LEU could be recovered in a straightforward manner. Iran has stated that it intends to recover near 20 percent LEU from scrap. According to the May 2015 IAEA safeguards report on Iran, "In a letter dated 28 December 2014, Iran informed the Agency [IAEA] of the operational schedule for FPFP [Fuel Plate Fabrication Plant at Esfahan] and indicated its intention to establish process lines for the recovery of uranium from solid and liquid scrap. In its reply dated 19 January 2015, the Agency requested that Iran provide further clarification. On May 19 2015, the Agency observed that the process lines had yet to commence operation and that Iran has continued its R&D activities related to the recovery of uranium from solid scrap." It is unknown how much near 20 percent LEU scrap Iran intends to recover. However, Iran moving to institute a scrap recovery capability poses a challenge to the deal, since the recovered LEU and the knowledge and experience gained by operating a scrap recovery operation would potentially allow Iran to speed up breakout.

The Obama Administration has been reluctant to discuss publicly the near 20 percent LEU and the media has largely missed this controversy. The April U.S. Fact Sheet does not discuss its fate at all. It does discuss a cap of 300 kg of LEU hexafluoride in Iran but this cap refers to LEU enriched under 3.67 percent and not the near 20 percent LEU.

U.S. officials have stated that the near 20 percent remaining in Iran would need to be mixed with aluminum, a step in making the fuel, or be in TRR fuel elements. Once so mixed, U.S. officials have stated that they remove this near 20 percent from consideration in breakout calculations. However, is this condition justified? The U.S. condition in fact may undermine its claim that the limits on Iran's centrifuge program achieve a 12-month breakout.

The near 20 percent LEU stock, unless largely eliminated or rendered unusable in a breakout, could be an important reserve in reducing the time to produce the first significant quantity of weapon-grade uranium and/or rapidly producing a second significant quantity of weapon-grade uranium (WGU).

The U.S. assessment is apparently that recovery of the near 20 percent LEU from aluminum, its subsequent conversion to uranium hexafluoride, and further enrichment would take so long that this LEU could not contribute significantly to a breakout in 12 months, or at least not to the first significant quantity of weapon-grade uranium. However, recovery of the near 20 percent LEU can be straightforward and the U.S. evaluation requires greater scrutiny. In Iraq's crash program to a nuclear weapon in 1990-1991, it put in place a capability to recover about 33 kilograms (uranium mass) of safeguarded unirradiated and slightly irradiated highly enriched uranium (HEU) from research reactor fuel. Based on Iraqi declarations and IAEA Action Team evaluations, which we possess, Iraq covertly installed the necessary equipment at the Tuwaitha nuclear site in four months. It would have needed about a month to test the equipment with dummy fuel and another five months to recover the HEU from the fuel. This effort was stopped at the point of testing dummy fuel elements by the Gulf War bombing campaign which started in January 1991. Because of its far greater experience with uranium conversion, Iran is likely able to recover unirradiated near 20 percent LEU at a similar or faster rate from TRR fuel elements than Iraq. If Iran were to break out, it would undoubtedly secretly install and test the recovery equipment prior to breakout. Such activities would be very difficult for the IAEA or intelligence agencies to detect. Thus, the Iraqi experience suggests that Iran could be recovering near 20 percent LEU from LEU/aluminum mixtures, scrap, and fresh TRR fuel soon after starting its breakout and recover tens of kilograms within several months. This recovered LEU could be converted quickly into hexafluoride form in facilities also prepared in secret prior to breakout.

Iran may already be gaining experience in separating LEU from aluminum. In addition to making TRR fuel, Iran notified the IAEA on December 28, 2014 that it would start manufacturing miniature fuel plates for the Molybdenum, Iodine and Xenon Radioisotope Production (MIX) Facility, for the production of Molybdenum 99 in the TRR. As of May 13, 2015 the IAEA confirmed that one fuel plate containing a mixture of U_3O_8 enriched up to 20 percent uranium 235 and aluminum were at the MIX Facility after transfer from the Fuel Plate Fabrication Plant and was being used for R&D activities for the production of specific isotopes, namely molybdenum 99, xenon 133, and iodine 132. According to the IAEA reports, since July 24, 2014, Iran has used 0.084 kg of near 20 percent uranium oxide for the purpose of producing molybdenum 99. As can be seen, the amounts of LEU used to make targets so far are very small. However, the processing of such targets after irradiation in the TRR can also provide experience in developing a capability to recover the LEU. Although the targets are processed to recover key isotopes, the processing provides experience in separating LEU from the aluminum.

In summary, the amount of Iran's near 20 percent LEU, in any form, should be reduced as much as possible to ensure that breakout periods remain at least 12 months, whether discussing overt or covert routes to a nuclear weapon. It is a mistake to leave large inventories of near 20 percent LEU in Iran in the form of scrap or in-process. The deal should require Iran to remove or blend down to natural uranium most of its near 20 percent LEU outside of TRR fuel. The obvious target is the expected 43 kg in oxide powder and the 130-134 kg in the form of scrap, waste, and in-process. These amounts total to 173-177 kg and represent roughly three quarters of Iran's stock of near 20 percent LEU. However, this step should be supplemented by irradiating any fresh TRR fuel. One method to do that is to irradiate all the TRR fuel, at least partially, to increase the complication of extracting the LEU from the fuel for use in a breakout.

Effect of 3.5 Percent LEU[9]

Another consideration is that Iran may accumulate additional up to 3.67 percent LEU over the limit of 300 kilograms LEU hexafluoride (equivalent). After the deal is implemented, Iran will produce 3.5 percent LEU each month. How will this material be disposed of so that the limit is not exceeded? Based on past performance, with about 5,000 IR-1 centrifuges enriching at Natanz, Iran will produce about 100 kg of 3.5 percent LEU hexafluoride each month. In order to avoid potential monthly violations of the 300 kg provision, the P5+1 and Iran must agree on what to do with the monthly product, e.g. whether to ship out or dilute to natural uranium the newly produced LEU every month. The accumulation of a few hundred kilograms of 3.5 percent LEU over the limit will lower the breakout times to near or just below 12 month, assuming no availability of near 20 percent LEU. Accumulations of more than 500 kilograms of 3.5 percent LEU hexafluoride start to lower breakout times more significantly, particularly with access to even relatively small amounts of near 20 percent LEU hexafluoride, namely 25-50 kg, or 17-34 kg LEU (uranium mass), which is only about 7-15 percent of Iran's stock of near 20 percent LEU.

The impact of large excess stocks of 3.5 percent LEU and the availability of residual stocks of near 20 percent LEU should also be considered. If Iran accumulates stocks of 3.5 percent LEU hexafluoride above 1,000 kilograms and can access relatively quickly only 50 kilograms of near 20 percent LEU hexafluoride, it could reduce breakout times to less than six months.

Effect of Re-Deployed IR-2m Centrifuges

A major gain in the April 2015 interim agreement is that Iran must dismantle its excess centrifuges and place them in monitored storage. For a time, negotiators considered leaving the centrifuges in place and disconnecting their piping. The latter option had the disadvantage of allowing a relatively rapid reinstallation of centrifuges, if Iran decided to breakout, with the result that it could lower breakout times below 12 months. Fortunately, this option was dropped.

However, in the former, better option, reinstallation also needs to be evaluated. Beyond the general provision, few details are available about this dismantlement and storage arrangement. A question is whether Iran could re-deploy a significant number of these centrifuges within several months of deciding to breakout. Armed with thousands more IR-1 centrifuges, or 1,000 of the more powerful IR-2m centrifuges, Iran could lower breakout times well below 12 months. It is important for Congress to obtain answers to the following questions: Where will the dismantled IR-2m centrifuges be stored and under what conditions? How quickly does the administration assess that these IR-2m centrifuges could be brought back into operation at the Fuel Enrichment Plant or elsewhere? What is the basis for such an estimate? What would be the effect on the breakout timeline of the successful reestablishment of the 1,000 IR-2m centrifuges at Natanz or elsewhere during the first six months of a breakout? Without answers to these questions, the information is not sufficient to allow us to analyze the possibility of significantly

[9] For additional detail and sources see: Albright and Kelleher Vergantini, "Iran's Stock of Less than Five Percent Low Enriched Uranium, June 2015 Update" ISIS Report, June 2, 2015, http://isis-online.org/uploads/isis-reports/documents/Irans_35_stocks_of_LEU_June_2015_Final.pdf

lowering breakout timelines via reinstallation of excess centrifuges, particularly IR-2m centrifuges. In evaluating a final deal, this issue needs to be carefully scrutinized.

Breakout Estimates in Years 10-13 and afterwards

There is little information in the Fact Sheet or elsewhere about the numbers and types of centrifuges the agreement allows Iran to install in from years 10 through 13. Based on discussions with negotiators, these values will be controlled by limitations on the numbers and types of centrifuges and on the separative work output. According to one negotiator, the goal is to allow a buildup in Iran's centrifuge capability that will reach an agreed breakout time of six months in year 13. The centrifuge arrangements from years 10 through 13 are said to be complex, particularly since Iran will undoubtedly want to deploy advanced centrifuges and will unlikely want to deploy IR-1 centrifuges. A shift to deployment of advanced centrifuges complicates the analysis because so little is known about their capabilities and performance. There is scant independent information about Iran's advanced centrifuges, such as the type of information about IR-1 centrifuges available from the IAEA. In any case, information about these centrifuge arrangements in years 10 through 13 is unavailable at this time. Breakout evaluations must await this information, although they may be far more uncertain than ones involving IR-1 centrifuges.

The Fact Sheet mentions very few restrictions past year thirteen of any deal. An important question is what will Iran's breakout time be at year 14 and 15 and afterwards? There appears to be no limitations that would prevent Iran from reducing its breakout time significantly after year 13 of a deal. In fact, Iran could quickly develop breakout timelines in years 14 and 15 that would be measured in less than a few weeks.

7) What challenges do you foresee in verifying Iranian compliance with a prospective agreement?

Verifying Iran's compliance with an agreement could be straightforward, but history suggests that it will not. Several challenges that could be faced include:

- Ensuring that sneak out to produce weapon-grade fissile material is detectable quickly;
- Iran's historically poor track record on adherence to its safeguards agreement and on-going non-cooperation with the IAEA could reoccur during the deal, complicating verification and the determination of either compliance or violations;
- Coping with incremental cheating on the provisions of the deal, in particular getting Iran to backtrack or stop such cheating;
- Guaranteeing that Iran's stock of LEU goes down to 300 kg and stays there. There are many potential problems. Equipment problems, whether real or faked, could delay blend down operations. Iran could delay shipments overseas because it cannot find buyers willing to pay Iran's price or use the LEU to make fuel.

- Reducing Iran's stock of unirradiated near 20 percent LEU. In addition to the breakout concerns discussed earlier, if this LEU stock is not reduced significantly in size, it may be difficult to prevent Iran from recovering near 20 percent LEU from scrap for use in the Tehran Research Reactor. Iran may argue that it does not have enough fuel to operate the reactor. Moreover, if stopped from recovering this LEU from scrap, Iran may press to enrich new near 20 percent LEU to fuel the TRR. To head off this potential development, the agreement should commit and facilitate Iran buying near 20 percent fuel from abroad.

- Assuring a P5+1/Iran dispute resolution or violation resolution mechanism functions quickly and adequately to address problems. The P5+1/Iran mechanism may clash with the IAEA's dispute resolution method, which typically involves taking problems or non-compliance to the Board of Governors. Iran may seek to exploit these differing dispute resolution methods to its advantage.

- Ensuring prompt IAEA access to suspicious sites without undue delays, assuming that the Iran will commit to IAEA access of all sites;

- Iran seeking to weaken or reverse agreed upon transparency arrangements;

- Ensuring that Iran is abiding by the rules of the procurement channel. Moreover, it may be difficult to persuade other states, such as China, to implement and enforce these rules;

- Detecting and thwarting any unauthorized imports for a covert Iranian nuclear program or to accumulate goods for use in surging centrifuge production once the deal's provisions end or Iran decides to walk away from the deal;

- Convincing other countries to enforce new or on-going controls and sanctions aimed at preventing Iran from making unauthorized imports of goods;

- Unauthorized research and development, and experimentation at declared or undeclared sites;

- Iranian military constituencies, or even civilian ones, not treating the obligations in the deal as seriously as the Atomic Energy Organization of Iran. These Iranian constituencies or entities may not view the consequences the same way, and they may be more willing to violate aspects of the deal in pursuit of their own aims. This problem may arise in particular with regard to the procurement channel but it could also occur if a military entity seeks to undertake work useful for the development of nuclear weapons;

- Maintaining implementation and verification of a deal as a major U.S. priority; and

- Guarding against downplaying future violations of a long term deal for the sake of generating or maintaining political support for the deal.